

A Note on Employment and Wage Polarization in the U.S.*

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Abstract

We compare employment and wage polarization in the U.S. using different sample periods and the inclusion or not of agricultural occupations. We report three main findings. First, we show that a similar degree of employment polarization can emerge together or without wage polarization, depending on the sample period considered. Next, we show that removing agricultural occupations from the sample dramatically changes the results with respect to the case in which these are included: i) wage polarization emerges and the degree of employment polarization increases and ii) the timing of employment polarization changes, and some U-shape of changes in employment shares is observed before 1980.

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1 Introduction

Employment polarization refers to the observation that employment shares at the bottom and at the top of the U.S. occupational skill distribution increase over time, while those in the middle of the distribution decrease. Wage polarization refers to the faster growth in real wages for occupations at the top and at the bottom of the occupational skill distribution, relative to occupations in the middle. Both employment and wage polarization have been extensively studied for the U.S. However, the fact that the two phenomena might or might not *co-exist* has received less attention in the literature. In this note we address this issue, starting from the observation that different works typically differ in the sample period and the inclusion or not of agriculture occupations. We show that these relatively minor differences in the sample data are crucial for the co-existence of the two phenomena. More specifically, we aim at comparing the results emerging from different sample choices by taking as reference four works: [Acemoglu and Autor \(2011\)](#), [Acemoglu and Autor \(2012\)](#), [Autor and Dorn \(2013\)](#) and [Bárány and Siegel \(2018\)](#). We compare different methodologies by using the smoothed graphs of changes in employment shares by 1980 percentiles of occupations, which are typically used in these works.

First, we ask whether employment polarization is always accompanied by wage polarization across sample periods.¹ The answer is no, as a similar pattern of employment polarization in the U.S. can emerge both together and without wage polarization, depending on the time period considered. More specifically, we find substantial heterogeneity in the behavior of wages at the bottom of the skill distribution in different sample periods. This observation suggests caution in assessing the goodness of a theory by its ability in jointly explaining employment and wage polarization. In fact, such theories display clear predictions on the evolution of employment and wages along the skill distribution, once the assumptions on technical change, and consumption and production elasticities are made.² Thus, on the one hand existing theories cannot account for the fact that only the behavior of wages might change, with that of employment remaining the same. On the other hand, considering slightly different time periods can align a specific theory with the data or not. This is because small differences in the sample period considered can create large differences in measured wage polarization, while leaving employment polarization substantially unchanged. However, the behavior of wages might help discern between the validity of employment polarization theories that aim to explain employment and wage patterns of *specific* time periods. This is

¹In this paper we use the average wage rank as a proxy for skills, as typical in the literature. See [Sevinc \(2019\)](#) for the analysis of employment and wage polarization in the U.S. using other proxies for the skill level.

²See for instance [Autor and Dorn \(2013\)](#), section D.

especially important for informing the policy debate.

Second, we investigate the role of agricultural occupations in generating employment and wage polarization. Some works, like [Acemoglu and Autor \(2011\)](#) and [Acemoglu and Autor \(2012\)](#) include agricultural occupations in constructing employment polarization graphs, while some others, like [Autor and Dorn \(2013\)](#) and [Bárány and Siegel \(2018\)](#), exclude them. We note here that, although the value added and consumption shares of agriculture are already small in the U.S. in 1980, the employment shares of agricultural *occupations* is not negligible (2.88%). Coupled with the fast disappearance of agricultural employment in the U.S. ([Buera and Kaboski, 2009](#)), the role of these occupations can be substantial when measuring employment polarization. This should be especially true at the bottom of the skill distribution, where agricultural occupations are concentrated in 1980, the reference year for the ranking of occupation by mean wage. We show that removing agricultural occupations magnifies the extent of employment polarization by creating a larger increase of employment shares at the bottom of the distribution, compared to the case in which these occupations are included. Regarding wages, we find no evidence of polarization when agriculture occupations are included in the sample, while some wage polarization emerges when agricultural occupations are excluded. This result implies that the choice of including agricultural occupations in the sample is key when confronting theory and data, as it can determine the contemporaneous emergence of employment and wage polarization. Also, it suggests that when agricultural occupations are included in the sample, the behavior of employment and wages at the bottom of the occupational skill distribution is largely driven by fast technological change in the agricultural sector, which is typically of the labor-saving type ([Bustos, Caprettini, and Ponticelli, 2016](#)).

The remainder of the paper is as follows. Section 2 discusses the co-existence of employment and wage polarization across sample periods. Section 3 shows the results obtained by including or not agricultural occupations. Finally, section 4 concludes.

2 Employment and Wage Polarization

Here we show that, depending on the sample period considered, employment polarization can emerge together or without wage polarization. We use [Acemoglu and Autor \(2011\)](#) codes and [Dorn \(2009\)](#) classification.³ Figure 1 reports employment and wage polarization for two different data sample: 1980-2008 and 1980-2017.⁴ While employment polarization

³This methodology includes agricultural occupations.

⁴Sources of data are the Census IPUMS for 1980 and Census American Community Survey for 2008 and 2017. Occupation and earnings measures refer to prior year's employment. Employment polarization figures plot log changes in employment shares while wage polarization figures plot log changes in mean real

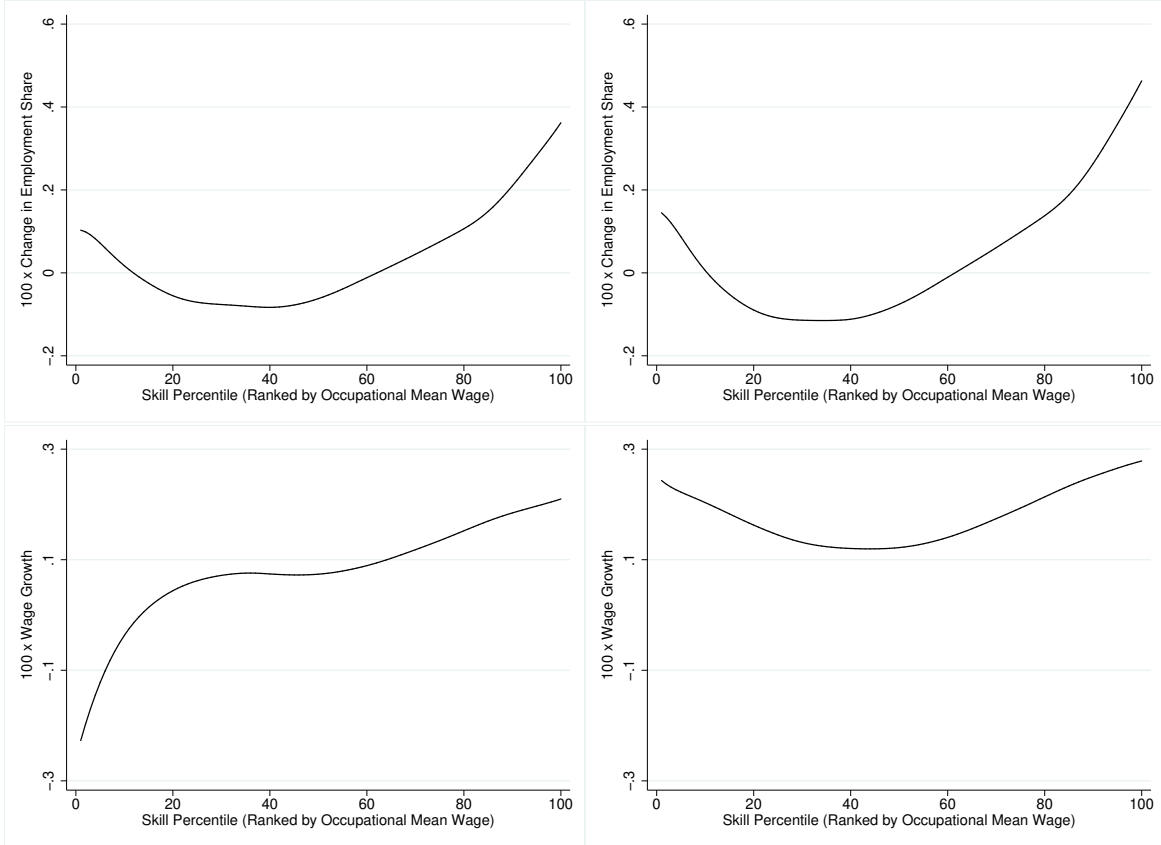


Figure 1: Employment (top) and Wage Polarization (bottom); 1980-2008 (left) and 1980-2017 (right). Occupations classification is from [Dorn \(2009\)](#).

is similar in the two samples, displaying the typical U-shape in both, the pattern of wages in substantially different. This shows an almost monotonically increasing behavior for the 1980-2008 period and a clear U-shape for the 1980-2017 period.⁵

To better show the contribution of the additional data in the second sample, Figure 2 reports employment and wage polarization by decade for the period 1980-2017.⁶ The period 2008-2017 displays a behavior of employment polarization which is similar to that of the 1990-2000 in the bottom part of the skill distribution, and similar to that of the 1980-1990 in the upper part. For this reason, adding this decade does not change the shape of employment polarization, while it affects the magnitude. Instead, the pattern of wage polarization is

wage by 1980 occupational skill percentile rank using a locally weighted smoothing regression (bandwidth 0.8 with 100 observations). Skill percentiles are measured as the employment-weighted percentile rank of an occupation's mean log wage in the Census IPUMS 1980 (5% extract). The mean log wage of each occupation is obtained from dividing annual income by workers' yearly working hours multiplied by Census weights.

⁵ACS 2008 reports wages from 2007, so the Great Recession does not affect the results.

⁶For the sake of exposition we admittedly abuse terminology along the text by referring also to the 2000-2008 as a decade.

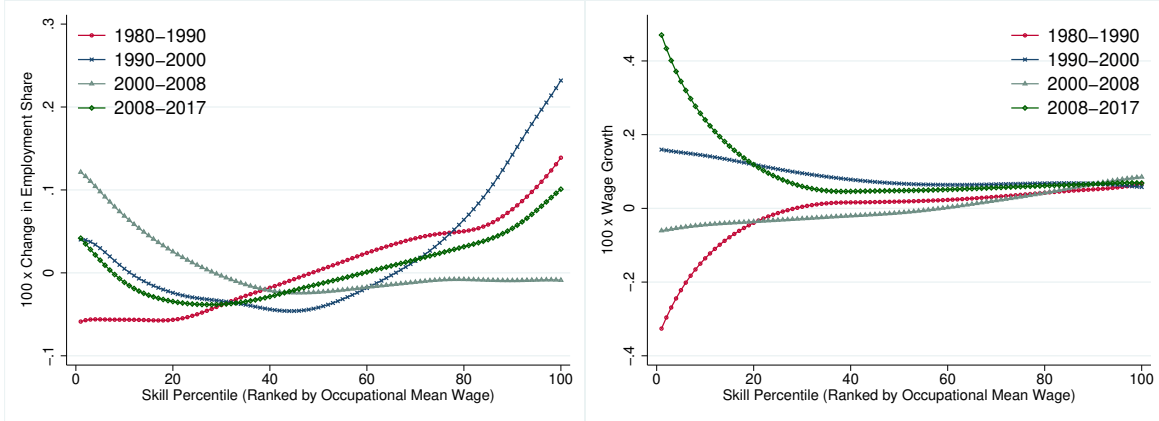


Figure 2: Employment (left) and Wage (right) Polarization by decades. Occupations classification is from [Dorn \(2009\)](#)

substantially different across decades. In particular, this is true for the bottom of the skill distribution. The last decade displays a substantial increase in wages at the bottom of the distribution, something in stark contrast with the other periods. Among the latter, in fact, only the 1990-2000 displays an increase at the bottom of the distribution, and this increase is substantially smaller than the 2008-2017 period.

Particularly relevant appears the comparison between the periods 1990-2000 and 2008-2017. While both periods display a similar magnitude of employment polarization at the bottom of the distribution, this is not mirrored by a similar change in wages, with the later period displaying a substantially stronger increase. In addition, analyzing the 1980-1990 and the 2000-2008, it appears that either combination of changes in employment and wages can occur at the bottom of the skill distribution: i) a *higher* increase of employment shares and a *smaller* increase in wages with respect to the 1990-2000 and 2008-2017 periods, which is the case of the 2000-2008 period; or ii) a *smaller* increase of employment shares and a *smaller* increase in wages with respect to the 1990-2000 and 2008-2017 periods, which is the case of the 1980-1990 period.

The heterogeneous behavior of employment and wages across decades suggests caution in assessing the goodness of a theory by its ability in jointly explaining employment and wage polarization, especially over longer horizons, as typically made in the employment polarization literature.⁷ In fact, once the assumptions on technical change and consumption and production elasticities are made, such theories display univocal directions for the joint evolution of employment and wages along the skill distribution. Such univocal directions appear difficult to reconcile with the patterns in Figures 1 and 2.⁸

⁷A notable exception is [Beaudry, Green, and Sand \(2016\)](#).

⁸For instance, in [Autor and Dorn \(2013\)](#), in which technological change is given by a declining price of

3 Including and excluding agriculture

In this section we study the role of agricultural occupations.⁹ The literature does not explicitly discuss the role of these in generating employment polarization, and there are cases in which they are included (Acemoglu and Autor, 2011, Acemoglu and Autor, 2012 and, more recently, Autor, 2019 and Comin, Danieli, and Mestieri, 2020), and cases in which they are not (Autor and Dorn, 2013 and Bárány and Siegel, 2018).¹⁰

Although the value added and consumption shares of agriculture are already substantially low in the U.S. in 1980, the employment share of agricultural *occupations* (2.88%) is not negligible when considering occupational percentiles. In addition, since occupations are typically ranked by mean wages in 1980, agricultural occupations are located at the bottom of the skill distribution. Also, the share of agricultural employment in the U.S. displays a fast decrease during the entire twentieth century (Buera and Kaboski, 2009). For all these reasons, it turns out that the choice of including or not these occupations is quantitatively relevant for measured employment and wage polarization. The top row of Figure 3 reports employment polarization with and without agricultural occupations. The main difference is that, in the latter case, the increase of employment shares at the bottom of the distribution is larger. The top row of Figure 4 shows that this is true for each decade in the 1980-2008 period. Thus, excluding agriculture occupations has two main effects: i) it shifts back in time the emergence of employment polarization; and ii) it magnifies the extent of it. The different timing is even more evident when reconstructing Figure 5 in Acemoglu and Autor (2012), which we do in the bottom row of Figure 4. With agricultural occupations, employment polarization emerges clearly from 1990 onwards. Without them, there is employment polarization in both periods. This is due to the fact that employment shares of agricultural occupations decline over the period and that they are located at the bottom of the skill distribution in 1980. Thus, removing them reduces the decline of employment shares at the bottom of the distribution.

computer capital over time, if the elasticity of substitution in production between computers and routine labor is high relative to the elasticity of substitution in consumption between goods and services, and the latter is less than or equal to unity, employment polarization emerges together with wage polarization. Thus, unless there is a change over time in some elasticity, the model cannot account for a change in the behavior of wages coupled with an unchanged behavior of employment.

⁹Agricultural occupations are those included in group D named “Farming, Forestry, and Fishing Occupations” in the occ1990dd classification in Dorn (2009) with codes 473 to 498.

¹⁰Acemoglu and Autor (2011) and Acemoglu and Autor (2012) do not explicitly discuss the inclusion of agricultural occupations in their sample when constructing, respectively for the two works, their Figure 10 and Figure 5. However, this can be inferred by comparing Figure 10 in Acemoglu and Autor (2011) with the top of our Figure 6 below. The same applies to Figure 5 in Acemoglu and Autor (2012) and the bottom row of our Figure 4. For all graphs we use codes downloaded from Daron Acemoglu’s website (<https://economics.mit.edu/faculty/acemoglu/data/handchapter>).

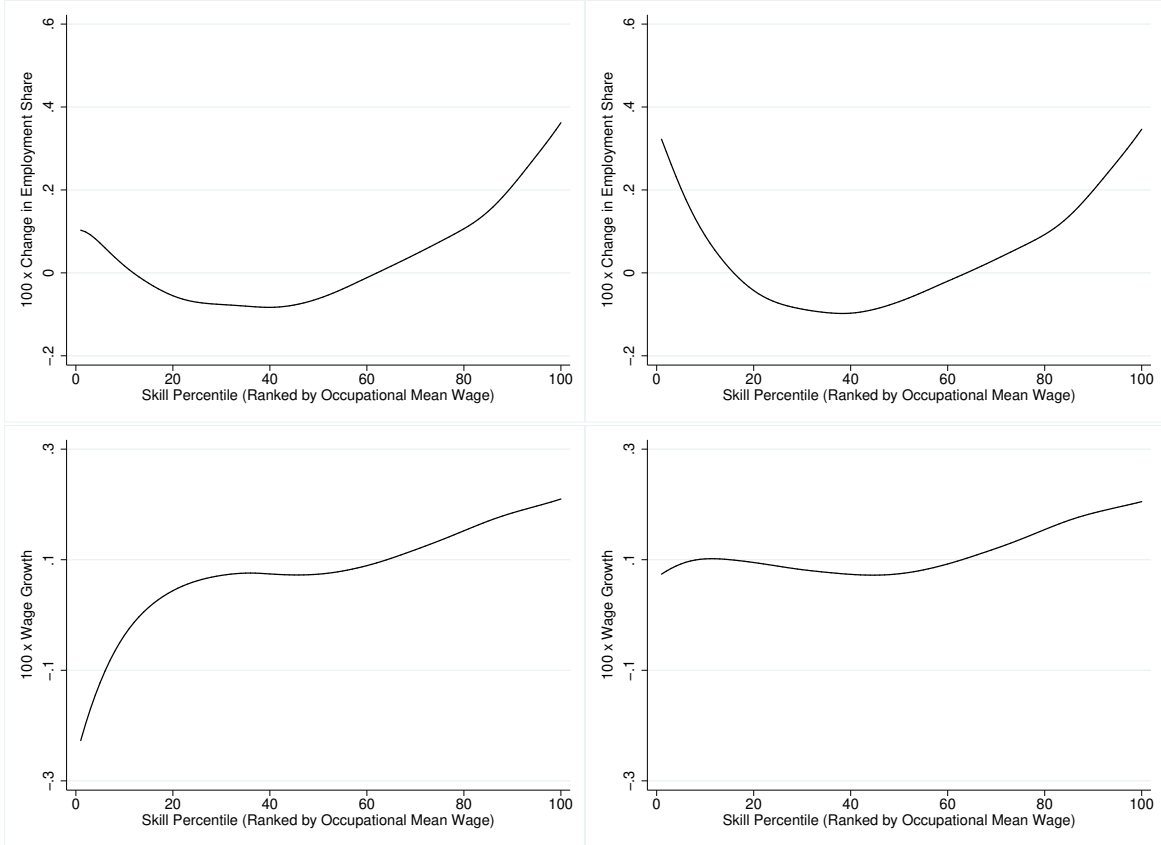


Figure 3: Employment (top) and Wage Polarization (bottom) in the 1980-2008; including (left) and excluding (right) agriculture occupation categories.

The bottom row of Figure 3 reports the evolution of wages in the two cases. When agricultural occupations are included there is no wage polarization. This mildly emerges when they are excluded. Thus, while employment polarization is maintained in the two cases, for wage polarization to emerge in the 1980-2008 period agriculture occupations have to be dropped from the sample.

Taken together, these results suggest that the choice of including or removing agricultural occupations in the sample is key when confronting theory and data, as it can determine the contemporaneous emergence of employment and wage polarization. Thus, as discussed for the sample period, this choice also determines the extent to which a theory fits the data on both employment and wages. In addition, our results suggest that when agricultural occupations are included in the sample, the behavior of wages at the bottom of the occupational skill distribution is largely driven by fast technological change typically measured in the agricultural sector, which is of the labor-saving type (Bustos, Caprettini, and Ponticelli, 2016).¹¹

¹¹The disappearance of a large fraction of occupations after 1980 (especially those in the middle of the

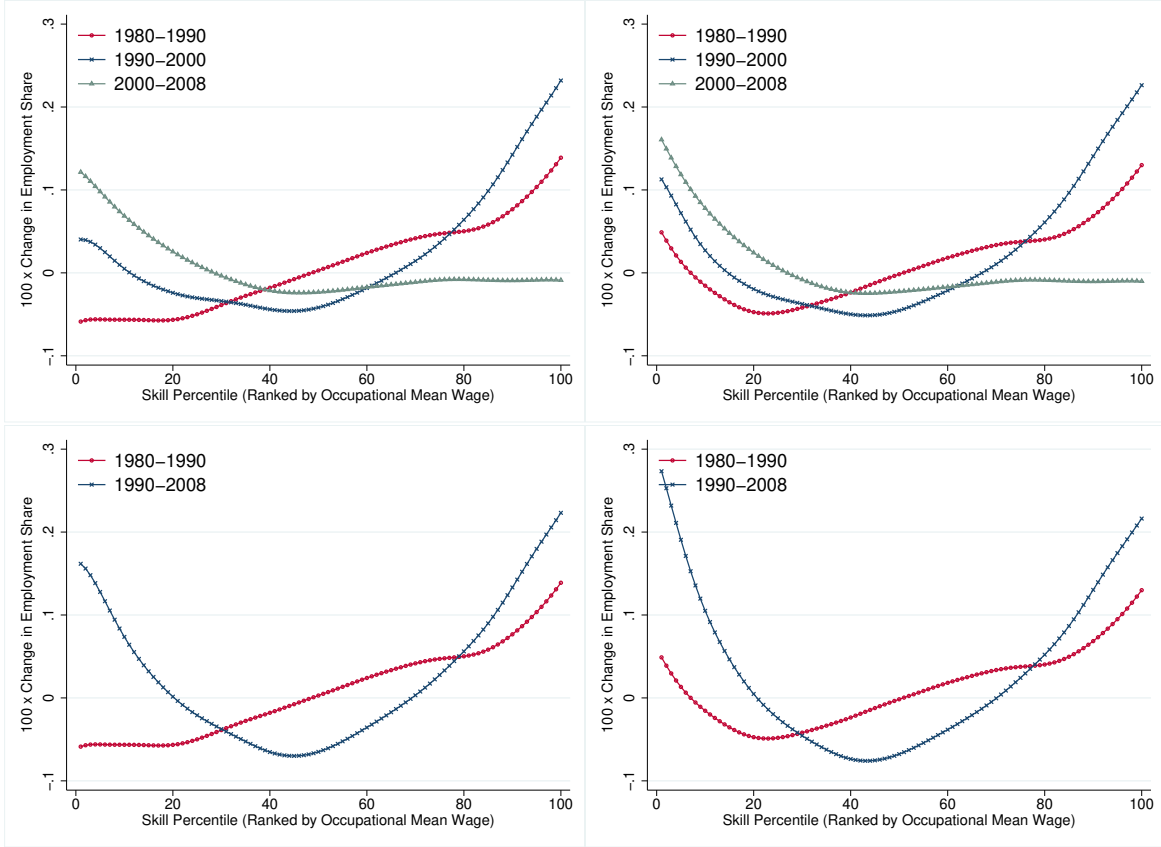


Figure 4: Top row: Employment polarization by decades during the 1980-2008, including (left) and excluding (right) agriculture occupation categories Bottom row: Employment polarization in the sub-periods 1980-1990 and 1990-2008 by including (left) and excluding (right) agriculture occupation categories.

Finally, Figure 5 reports the effect of including or excluding agricultural occupations when computing employment polarization for the 1960-1980 period. In this case, the occupations classification in Dorn (2009) cannot be used, because some of the occupations existing in 1980 do not exist in the previous decades. Thus, Bárány and Siegel (2018), who study employment and wage polarization since 1950, create a new classification by merging occupations in 1980 into a smaller set (183 occupations) than in Dorn (2009) (326 occupations).¹² In this way, occupations that appear only in a sub-period and not in another one, are now included in a

skill distribution) is often attributed to *routine biased technological change* (RBTC), which makes workers performing occupations with repetitive and codifiable tasks redundant (Autor and Dorn, 2013). However, the share of *routine workers* in agricultural occupations is zero in 1980 and in subsequent periods. Thus, RBTC does not appear to play a role in shaping employment and wages for such occupations. We define routine occupations as in Autor and Dorn (2013).

¹²For the 1980-2008 both classifications in Dorn (2009) and Bárány and Siegel (2018) deliver a similar qualitative and quantitative pattern. Results can be found in Cerina, Moro, and Rendall (2020).

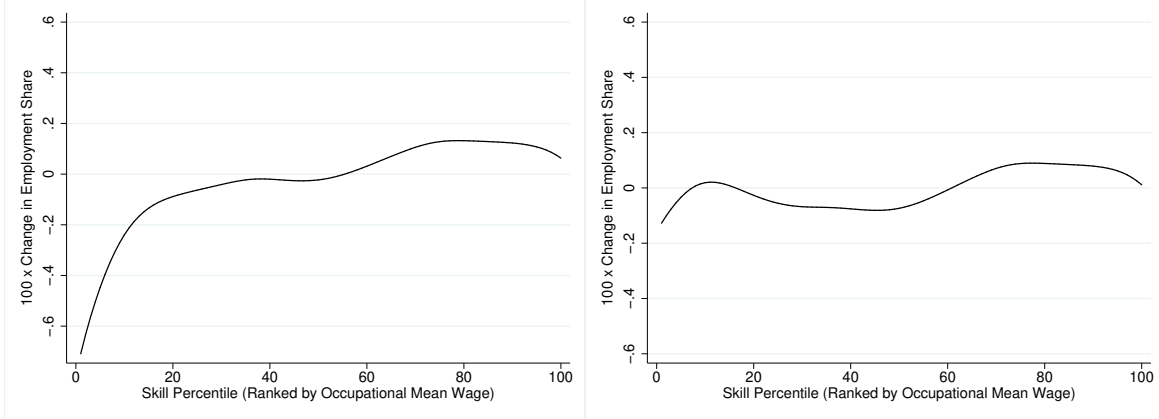


Figure 5: Employment Polarization in the 1960-1980 period. Left: including agriculture occupations; right Excluding agriculture occupations.

broader occupation category that is present in the whole sample period 1950-2008.¹³ In what follows, we use the classification by [Bárány and Siegel \(2018\)](#). Figure 5 shows that including agriculture occupations, there is a large decline of employment shares at the bottom of the distribution. This reflects the fall of agriculture employment during this period in the U.S., as the employment share of agricultural occupations declines from 7.34% in 1960 to 2.88% in 1980. By removing agricultural occupations, the large drop at the bottom disappears, and a U-shape can be appreciated, albeit much weaker than for the 1980-2008 period.¹⁴ Thus, the U.S. economy displays some employment polarization before 1980, as reported in [Bárány and Siegel \(2018\)](#), only if agriculture occupations are excluded. However, dropping agricultural occupations for the period 1960-1980 implies removing a large fraction of the labor force.

4 Conclusions

We study the co-existence of employment and wage polarization in the U.S. and we report three main findings. First, employment polarization can be associated or not with wage polarization. Employment shares at the bottom of the skill distribution can increase together or without an increase in wages in that part of the distribution. This observation suggests caution in assessing the goodness of a theory by its ability in jointly explaining employment and wage polarization. Intuitively, the joint behavior of employment and wages should reflect the evolution of supply and demand of labor in that part of the skill distribution.

¹³Technically, we use the code in [Acemoglu and Autor \(2011\)](#), and apply to it the occupation classification in [Bárány and Siegel \(2018\)](#), downloadable at <https://www.aeaweb.org/articles?id=10.1257/mac.20150258>.

¹⁴The pattern reported in the right panel of Figure 5 for the the 1960-1980 for the overall economy can be compared with the pattern for the 1950-1980 in Figure 1 in [Bárány and Siegel \(2018\)](#).

An increase in employment shares coupled with an increase in wages could signal a stronger labor demand effect, while a decrease in wages the opposite, i.e. a stronger labor supply effect. Across time these effects might be due to different factors, which can create similar employment polarization with different patterns of wages. Understanding how demand and supply effects might change at shorter horizons can help design better policies aimed at reducing the impact of labor market polarization on welfare.

Next, we report two results related to the inclusion or not of agricultural occupations in the sample: excluding them i) induces the emergence of wage polarization in the 1980-2008 period and magnifies the extent of employment polarization and ii) changes the timing of employment polarization making it appear earlier. The first result suggests that as for the sample period, the choice of including or not agricultural occupations determines the extent to which a theory fits the data on both employment and wages. The second result suggests that employment polarization in the pre-1980 period, as reported in [Bárány and Siegel \(2018\)](#), emerges only when excluding agriculture occupations.

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